PATENT SPECIFICATION 1,119,982

DRAWINGS ATTACHED.

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1,119,982

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COMPLETE SPECIFICATION.

Improvements in or relating to Roller Leveller Machines.

We, HEAD, WRIGHTSON AND COMPANY, LIMITED, a Company organised under the laws of Great Britain, of G.P.O. Box 10, Teesdale Iron Works, Thornaby-on-Tees, Yorkshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to roller leveller machines for metal sheet or strip and is concerned particularly with a method and means for providing improved pressure regulation in such machines.

In orthodox levelling machines, which consist of a top work roll assembly and a bottom work roll assembly each assembly being provided with, for example, three or more series of short back-up rolls for co-operation with the work rolls, it is the practice to adjust each series of back-up rolls so that the pressure applied to each of the work rolls is the same throughout the length of the machine, i.e. from the entry side to the exit side. The pressure applied by each series of back-up rolls can of course be varied to effect deflection of the work rolls in any desired manner but the result is that each work roll is deflected in the same manner, and to the same amount, so that the regulated pressure at the entry side of the machine is the same as that of the exit side of the machine.

Although this arrangement has produced satisfactory results, it is among the objects of the present invention to provide a method and means whereby the sheet or strip metal will be levelled more efficiently.

According to the present invention there is provided a method of levelling sheet or strip material by passing the sheet or strip through a roller leveller machine having top and bottom work roll assemblies and a series of short back-up rolls associated with each work roll assembly, characterized by controlling the co-acting back-up rolls of at least one of the work roll assemblies so that the extent of deflection of the individual work rolls decreases progressively from the entry side of the machine to the exit side of the machine.

According to the invention furthermore, there is provided a roller leveller machine for a sheet or strip of metal comprising a top work roll assembly, a bottom work roll assembly and a plurality of series of short back-up rolls associated with each work roll assembly, wherein each series of back-up rolls of the top and/or bottom work roll assemblies is adjustable in such manner as to cause deflection of the work rolls, the extent of said deflection being such that it decreases progressively from the work roll at the entry side of the machine to the work roll at the exit side of the machine.

Preferably each series of back-up rolls is mounted on a support frame or cradle which is angularly adjustable relative to a fixed pivot point arranged at or near the exit side of the machine.

The invention is illustrated by way of example in the accompanying drawings in which,

Figure 1 shows schematically the effect produced by known roller leveller apparatus.

Figure 2 shows schematically the effect produced by the machine according to the present invention.

Figure 3 is a cross-section, in part, through a machine according to the invention, the section being taken generally on the line indicated 3—3 in Figure 5.

Figure 4 is cross-section corresponding to Figure 3 but showing only the top work roll

assembly, the section being taken generally on the line 4—4 of Figure 5.

Figure 5 is an end elevation in part in the direction of the arrow 5 of Figure 4.

Figure 6 is a section corresponding to Figure 5 and taken on the line 6—6 of Figure 4, and

Figure 7 is a plan view corresponding to Figures 5 and 6.

Referring to Figure 1 of the drawings, which illustrates the effect produced by a known roller leveller machine where the work rolls of the top roll assembly only are flexed, there is shown a plurality of top work rolls 10 having operatively associated therewith a plurality of series of back-up rolls 11. As can be seen in the drawing, all the work rolls 10 are flexed by the back-up rolls 11 to the same degree so that the extent of flexure and thus the pressure regulation on the strip 12 of material being treated is the same at the entry side of the machine as it is at the exit side of the machine. The result of this, as is shown in the lowermost sketch, is that the line of minimum strain and penetration is in the form of a parabola and it will be understood therefore that a large proportion of each edge of the strip 12 is not accurately treated by all the work rolls. This is, as is obvious, with some materials disadvantageous since it leads to inaccurate flattening of the strip.

As will be seen in Figure 2 of the drawings, which shows the effect produced by the method and apparatus of the present invention, each series of back-up rolls 11 is operated in such manner that the extent of flexure of the work rolls 10 and thus the extent of pressure regulation on the strip 12 is progressively decreased from a maximum at the entry side of the machine to zero at the exit side of the machine. This, as can be seen in the lowermost sketch, results in a line of minimum strain and penetration which is straight and corresponds to the position of the work rolls at the exit side of the machine. Thus, in the arrangement of the present invention, the strip 12 being treated is influenced by the whole of each work roll throughout its passage through the machine.

Referring now to Figures 3 and 7 of the drawing there is shown a roller leveller machine for producing the effect shown in Figure 2 of the drawings, the machine in this case being of the type where the top works rolls only are flexed in order to vary the pressure applied across the width of the material being treated.

The machine comprises a supporting framework, generally indicated at 13, mounting a rop roll assembly 14 having a series of work rolls 15 and a bottom roll assembly 16 having a series of work rolls 17. The top and bottom roll assemblies are interconnected by links (not shown) in order to maintain accurate relationship therebetween and the work rolls 15 and 17 are supported in roller bearbearings, the bearings, at least of the rolls 15, being of the self-aligning type in order to reduce the bending stresses in the roll necks which result from flexing of the rolls.

The top roll assembly 14 is adjustable relative to the bottom roll assembly 16 in known manner in order to vary the gap between the two series of work rolls 15, 17 to suit requirements according to the thickness of the material being treated.

The top roll assembly 14 also includes a plurality, for example five, of series of back-up rolls 18 which extend in spaced parallel relationship over the length of the work rolls 15. For convenience, it will be noted that only one series and half of a second series of back-up rolls have been shown in Figures 5 to 7 of the drawings but it will of course be understood that the arrangement, construction and operation of each series of back-up rolls is exactly the same.

As shown, particularly in Figures 5 to 7, each back-up roll 18 consists of two spaced castor rollers 19 mounted for rotation on a stationary shaft 20 which is supported in a cradle 21 of generally H-shaped cross-section. The cradle 21 consists of two side members 22 and a transverse connector plate 23 reinforcement being provided by cross plates 24. The side members 22 are received, for vertical adjustment, in guide channels 25 formed in brackets 26 fixed to the roll assembly 14. The cradle 21 and thus also the back-up rolls 18 are biassed in a vertical direction by means of coil springs 27 which are arranged adjacent each corner of the cradle 21 on bolts 28 having retainer plates 29, the bolts being secured to the brackets 26.

Also housed within each guide channel 25 are a fixed bearing block 30 and an adjustable bearing block 31. The fixed bearing block 30 is positioned in the channel 25 adjacent the exit end of the work rolls and has an arcuate upper bearing surface 32 the radius of the arc being taken from a point corresponding to the axis of the last exit work roll. A support block 33 having an arcuate surface corresponding to that of the surface 32 is arranged between the bearing block 30 and the base of the channel 25, the support block 33 being positioned by means of a dowel 34 which is fixed to the bracket 26 to extend into the channel 25.

Arranged between the side member 22 of the cradle 21 and the bearing block 30 is a wedge member 35 which is adjustable lengthwise of the cradle 21 by means of a set screw 36. The contacting surfaces of the block 30 and the wedge member 35 are set at an angle to the horizontal so that lengthwise movement of the wedge member will effect vertical adjustment of the back-up rolls 18, relative to the work rolls 15 so that the relationship between the back-up rolls and the work rolls

can be accurately aligned to ensure that the full load from the work rolls will be taken up directly by the back-up rolls. In this respect, it should be pointed out that the adjustment just referred to is generally effected at the time of setting up the machine and further adjustment during use is not normally necessary.

The adjustable bearing block 31, which is of semi-circular cross-section, is positioned in the channel 25 adjacent the entry end of the work rolls and is arranged to co-operate with a support block 37 which is mounted for lengthwise sliding movement in the base of the channel 25. Arranged between the bearing block 31 and the side member 22 of the cradle 21 is a wedge member 38 which is adjustable lengthwise of the cradle 21 by means of a set screw 39. The contacting surfaces of the block 31 and the wedge member 38 are set at an angle to the horizontal to effect adjustment in the manner, and for the purpose, hereinbefore described with reference to the wedge member 35.

As shown in Figure 6, the contacting surfaces between the wedges 35 and 38 and the side members of the cradle 21 are of arcuate form to provide a seating.

Lengthwise movement in the channels 25 of the support blocks 37 is effective to vary the pressure of the back-up rolls 18 on the work rolls 15 so that the latter can be flexed to a varying degree to suit requirements. In this respect, it will be appreciated that movement of the support blocks 37 will cause relative movement between the bearing blocks 31 and their co-operating wedge members 38.

Adjusting movement of the support blocks 37 is effected by an adjuster plate 40 which is mounted for sliding movement between the brackets 26. One end of the adjuster plate 40 is provided with projections 41 to which the support blocks 37 are secured as by screw bolts 42. The other end of the adjuster plate 40 is formed with a rectangular opening 43 in which is fixed a threaded nut 44. The nut 44 receives one end of a threaded spindle 45 the other end of which is provided with a bevel gear 46 which meshes with a second gear wheel 47 arranged on control shaft 48.

It will be understood that operation of the control shaft 48 is effective to cause relative movement between the block 31 and the wedge member 38 so that the cradle 21 is moved angularly about the fixed pivot provided by the block 30. This movement causes flexing of the work rolls 15 in such manner that maximum deflection is applied at the entry side of the machine, the degree of deflection decreasing progressively throughout the series of work rolls so that, at the exit side of the machine, the deflection is zero.

As hereinbefore described, the construction and operation of each series (for example five) of back-up rolls 18 is the same and therefore it will be appreciated that, apart from providing progressively decreasing deflection of the work rolls 15, the apparatus is such that each series of back-up rolls can be adjusted independently of the other. By virtue of this, the work rolls 15 can be flexed at one end only, or at both ends to achieve a uniform curve, or in a sinusoidal manner either of regular or irregular form.

The means for moving the blocks 31 relative to their co-acting wedge member 38 may comprise hand operated wheels which are coupled to each block individually via a rotatable shaft and gearing. In this case, to reduce the space required where, for example, five series of back-up rolls 18 are provided, the hand wheels may be arranged side-by-side and their respective drive shafts mounted co-axially with one another. Thus, the outermost shaft would operate the first series of back-up rolls, the next shaft would operate the second series of back-up rolls, and so on.

Alternatively, as shown in Figure 4 of the drawings, all five series of back-up rolls 18 can be operated through gearing 46, 47 by means of the common control shaft 48 which is operated by a single handwheel or by a geared motor unit. In this latter case, the angles of the wedge members 38 will differ from one series of back-up rolls to the other and will be designed so that the centre portion of each work roll will be deflected most and progressively the pressure from the back-up rolls will be reduced towards the ends of the work roll. Under this progressive pressure arrangement the work rolls will be flexed to take up the shape of a naturally deflected beam.

As shown in Figure 3, the bottom work roll assembly is provided with back-up rolls 49 which are supported in a cradle 50 arranged on a pair of co-acting wedge elements 51, 52. The wedge element 51 is fixed relative to the cradle 50 and the wedge element 52 is movable relative thereto by means of a set screw 53. The purpose of this adjustment is to effect accurate vertical alignment of the back-up rolls 49 in relation to the bottom work rolls 17. A further set screw 54 is provided to cooperate with the cradle 50 to locate, during assembly, the position of the back-up rolls 49 relative to the work rolls 17 in a horizontal direction.

By using the method and means according to the invention the sheet metal being treated is influenced by all the work rolls throughout its passage through the machine. This results, as shown in Figure 2, in a line of minimum strain and penetration which corresponds to the position of the exit rolls of the machine, as compared with known machines (Figure 1) in which the line of minimum strain and penetration is in the form of a parabola thereby indicating that a large pro-

portion of the edges of the material are not accurately affected by all the work rolls.

Although the invention has been described with reference to the bottom work rolls 17 and back-up rolls 49 being stationary, it will be understood that the bottom work roll assembly 16 can be arranged in the same manner as that of the top work roll assembly 14 so that both banks of work rolls can be flexed.

WHAT WE CLAIM IS:—

1. A method of levelling sheet or strip material by passing the sheet or strip through a roller leveller machine having top and bottom work toll assemblies and a series of short back-up rolls associated with each work roll assembly, characterized by controlling the co-acting back-up rolls of at least one of the work roll assemblies so that the extent of the individual work rolls decreases progressively from the entry side of the machine to the exit side of the machine.

2. The method as claimed in claim 1, in which the individual work rolls are flexed, throughout their axial lengths, non-uniformly.

3. A roller leveller machine for sheet or strip metal comprising a top work roll assembly, a bottom work roll assembly and a plurality of series of short back-up rolls operatively associated with each work roll assembly, wherein each series of back-up rolls of the top and/or bottom work roll assemblies is supported independently and adjusting means are associated with the support of each series of back-up rolls to effect deflection of the co-acting work rolls, the adjusting means being arranged and constructed so that the extent of deflection of the work rolls decreases progressively from the work roll at the entry side of the machine to the work roll at the exit side of the machine.

4. A machine as claimed in claim 1, in which the support means for each series of back-up rolls comprises a cradle which is mounted for adjustment in a vertical direction on the work roll assembly.

5. A machine as claimed in claim 4, in which the cradle is biassed, as by spring means, in a direction where the back-up rolls tend to be moved away from the work rolls.

6. A machine as claimed in claim 4 or claim 5, in which the cradle is mounted, in brackets fixed to the work roll assembly, for angular movement about a fixed pivot arranged adjacent the exit side of the machine.

7. A machine as claimed in claim 6, in which the fixed pivot comprises a bearing block having an arcuate bearing surface co-operating with a support block fixed to the brackets, the radius of the arc being taken from a point corresponding to the axis of the last exit work roll.

8. A machine as claimed in claim 6 or claim 7, in which the adjusting means are arranged adjacent the entry side of the machine between the brackets and the back-up roll cradle.

9. A machine as claimed in claims 8, in which the adjusting means comprise a bearing block of semi-circular cross-section the base of which is slidably mounted on and angled surface attached to, or forming part of, the cradle and the arcuate surface of which is in engagement with a support block which is slidably mounted for controlled lengthwise movement relative to the brackets.

10. A machine as claimed in claim 9, in which means are provided for effecting movement of the support block said means comprising an adjuster plate slidably mounted between the brackets, one end of the plate being secured to the support block and the other end thereof being provided with a threaded nut which receives a threaded spindle which is connected by gearing to a control shaft.

11. A machine as claimed in claim 10, in which the control shaft is common to all of the plurality of series of back-up rolls.

12. A machine as claimed in claim 10, in which independent control shafts are provided for each series of back-up rolls.

13. A machine as claimed in any one of claims 7 to 12, in which wedge members are arranged between the fixed bearing block and the cradle, and between the adjustable bearing block and the cradle to effect, via adjusting means, accurate vertical alignment between the back-up rolls and the work rolls to ensure that the full load from the work rolls is taken up by the back-up rolls.

14. A machine as claimed in any one of claims 7 to 13, in which a dowel is provided between the support block associated with the fixed bearing block and the brackets to provide horizontal alignment between the back-up rolls and the work rolls.

15. The method of levelling sheet or strip material substantially as hereinbefore described.

16. A roller leveller machine substantially as hereinbefore described with reference to Figures 2 to 7 of the accompanying drawings.

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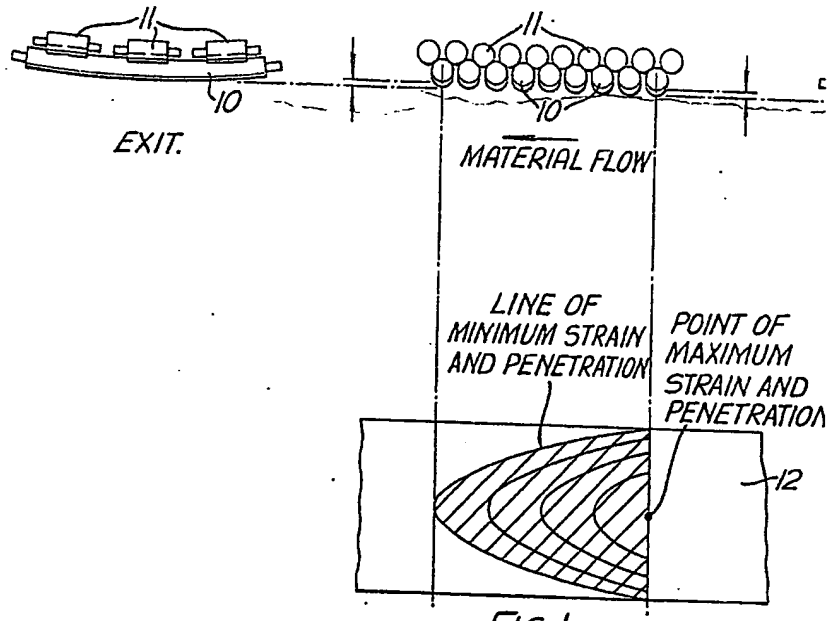
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EXIT.
MATERIAL FLOW
LINE OF MINIMUM STRAIN AND PENETRATION
POINT OF MAXIMUM STRAIN AND PENETRATION
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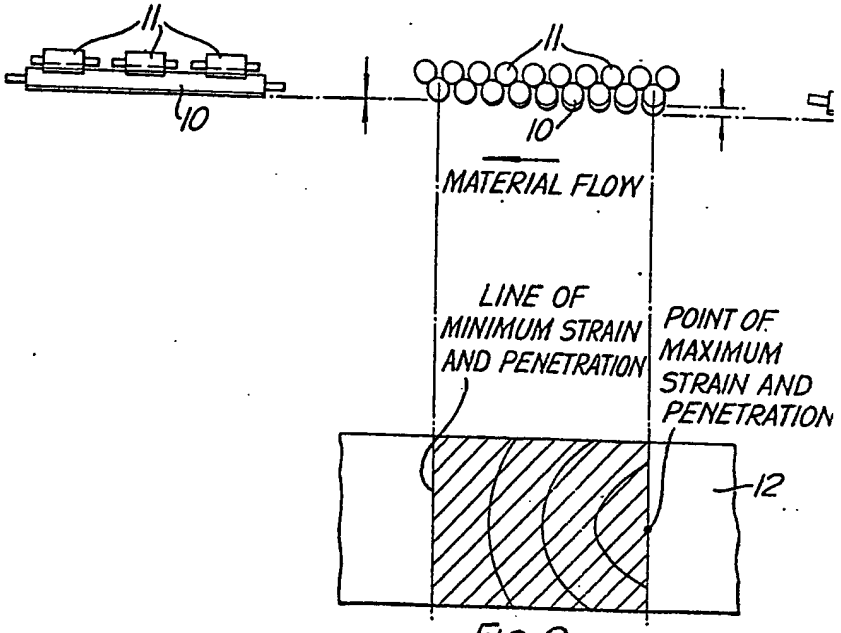
FIG. 1.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MATERIAL FLOW
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POINT OF MAXIMUM STRAIN AND PENETRATION
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FIG. 2.

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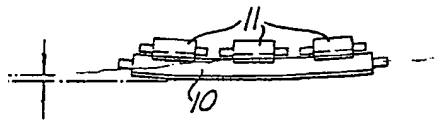

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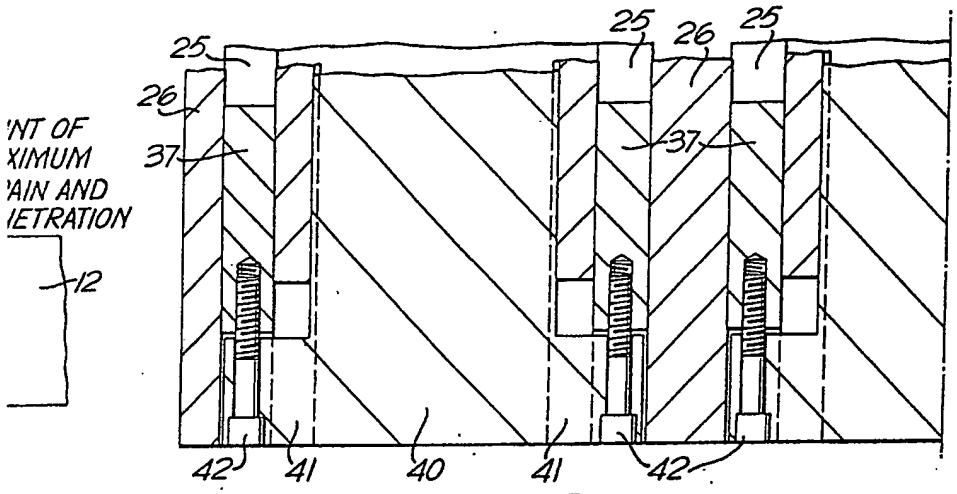

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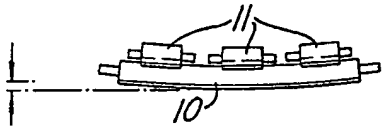
FIG. 7.



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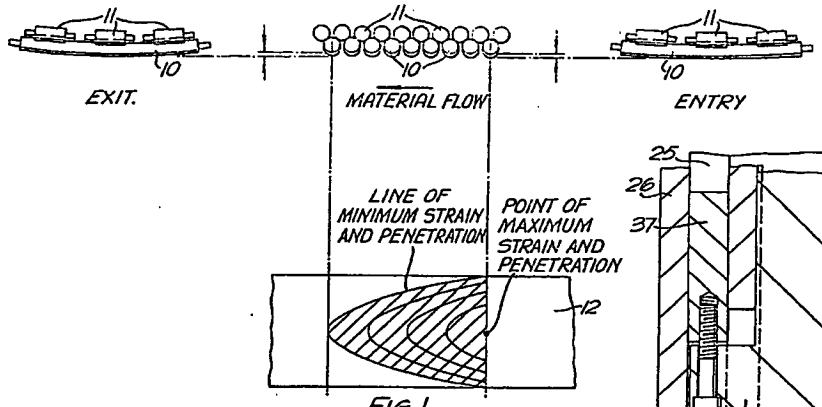

FIG. 1.

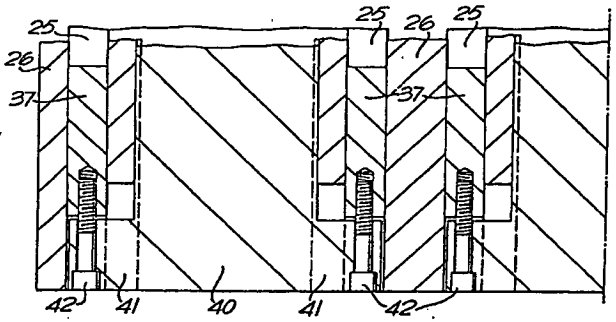

FIG. 7.

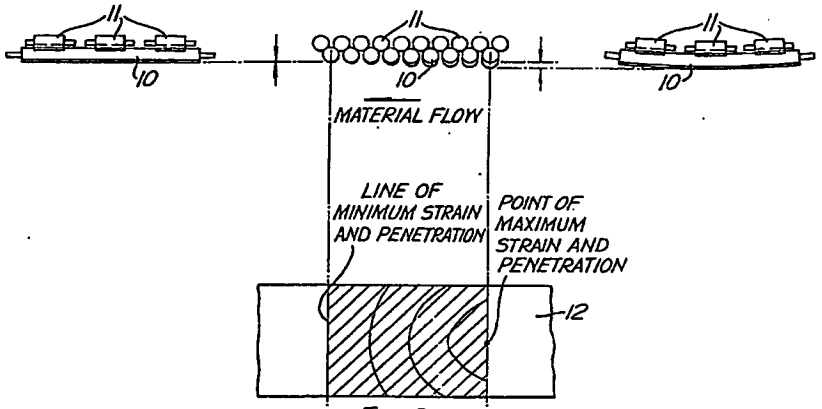

FIG. 2.

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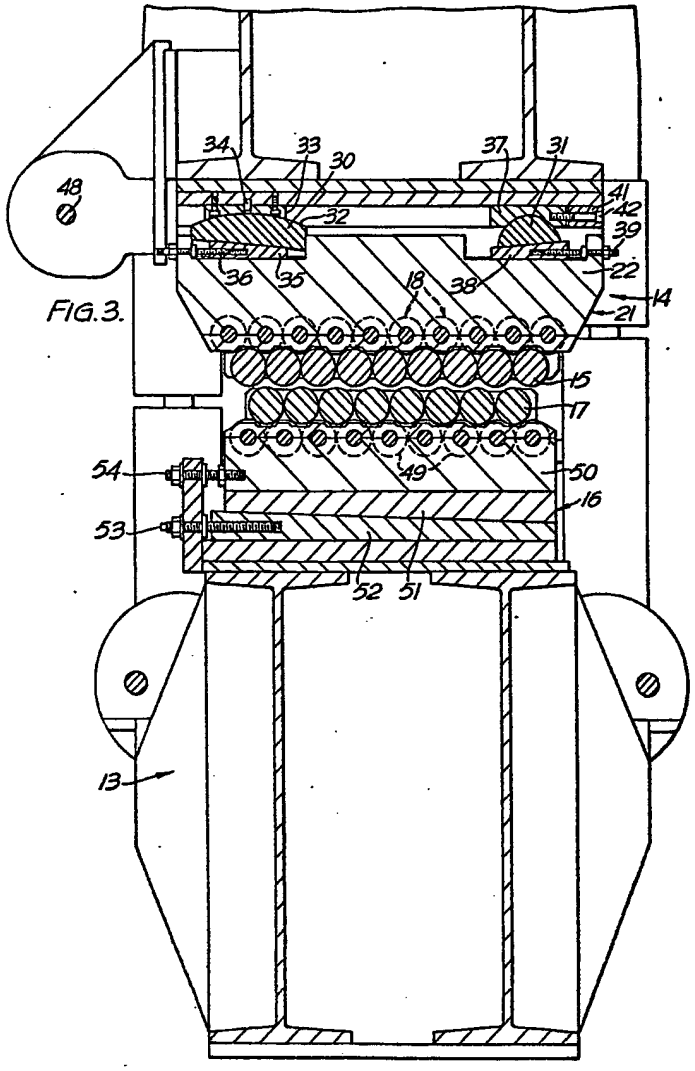

FIG.3.

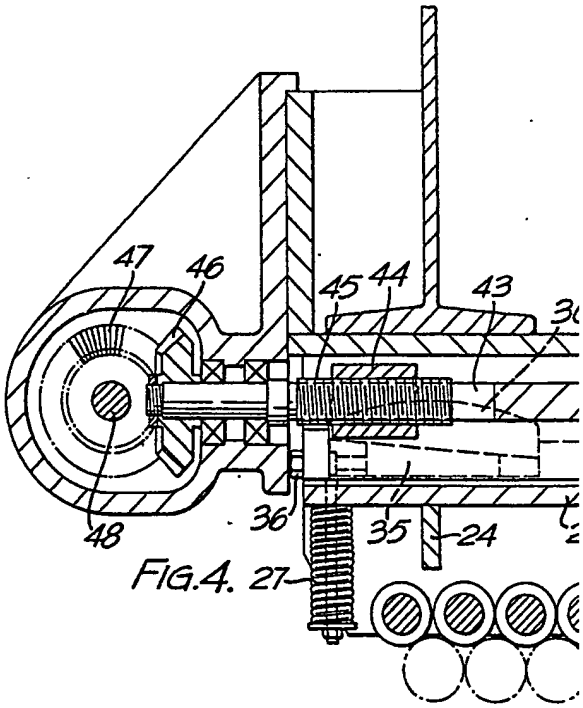
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FIG.4.

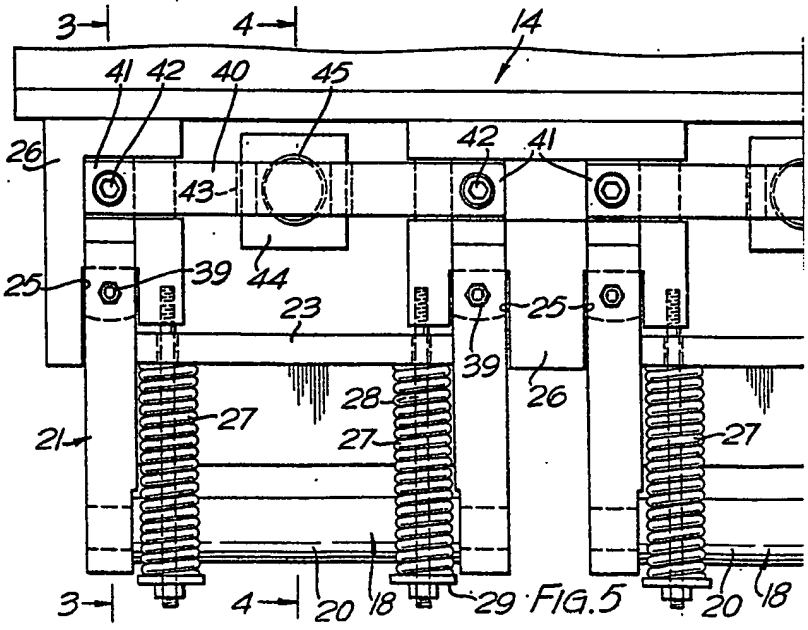
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FIG.5

1119982 COMPLETE SPECIFICATION
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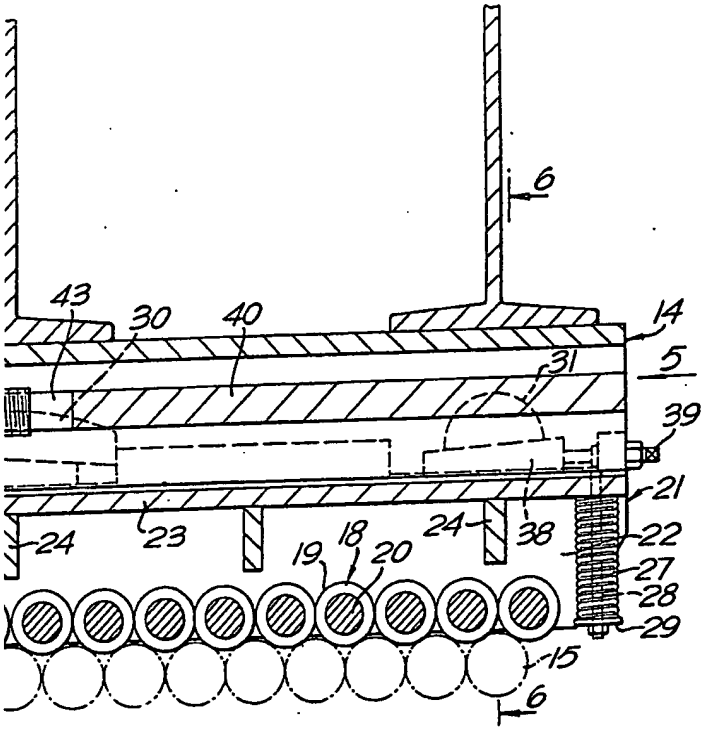

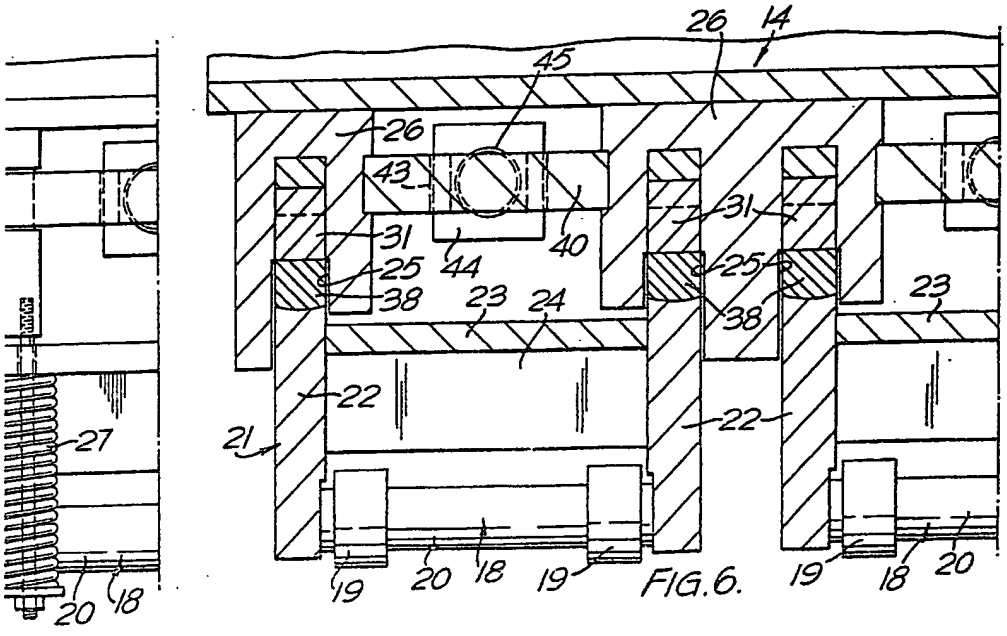

FIG. 6.

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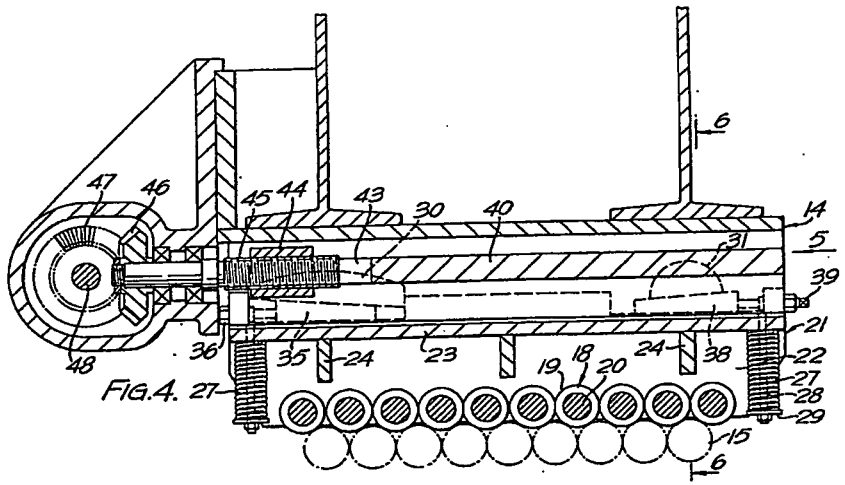

FIG.4.

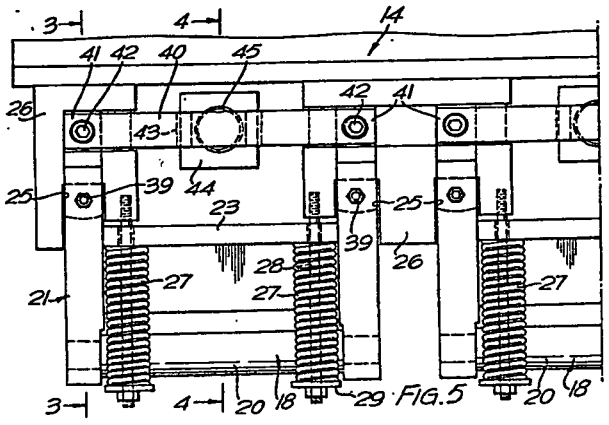

FIG.5

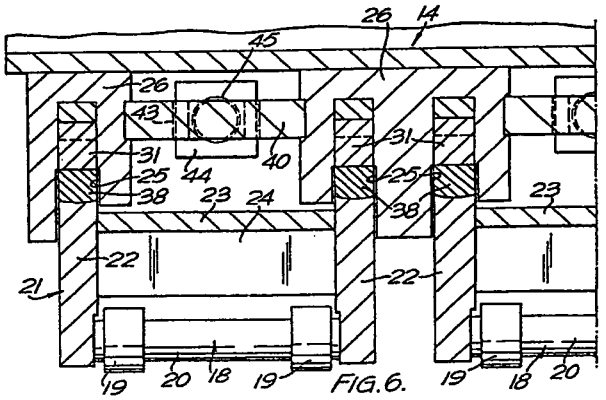

FIG.6.